

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

RECEIVED
CENTRAL FAX CENTER
MAY 11 2009

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method for generating a wide image video sequence using a device having at least two video cameras substantially co-located in a predetermined relationship to each other such that there will be an overlap between images from the respective cameras, said method comprising the steps of:

a. forming a synthetic image from images of the respective cameras by (i) identifying corresponding parts in overlapping parts of the images, (ii) determining the relation between the respective coordinates for the pixels in the individual cameras and in the synthetic image, and (iii) calculating calibration parameters from said relation, said calculated calibration parameters being unique for the at least two cameras and their current location as related to the object being recorded generating a set of calibration parameters related to a device having at least two video cameras which are arranged in a predetermined relationship to each other, said parameters being unique for the at least two cameras and their current location as related to the object being recorded;

b. ~~recording~~ synchronously recording video sequences using each of said at least two video cameras[~~],~~]; and

c. generating a wide image video sequence by combining from each of said synchronously recorded video sequences using said calculated calibration parameters.

2. (Currently Amended) A method according to claim 1, wherein in which the synchronously recorded video sequences are stored in a memory storage area means.

3. (Currently Amended) A method according to claim 1, wherein in which the synchronously recorded video sequences are used concurrently for generating the wide image video sequence.

4. (Currently Amended) A method according to claim 3, wherein in which the wide image video sequence is transmitted live.

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

5. (Currently Amended) A method according to claim 3, wherein in which the wide image video sequence is stored on a memory storage area means.

6. (Currently Amended) A method according to claim 1, wherein calculating the calibration in which the generation of calibration parameter; comprises the following steps:

- a. Start of starting a calibration process;
- b. Synchronize synchronizing the sequences from each of the at least two cameras camera, which means that at least a video sequence has to be recorded by all cameras;
- c. Compute computing inter-image projective transformations;
- d. [[Use]] using the transformations to refer each image to a common reference frame;
- e. Choose selecting a real or virtual reference camera such that certain lines on the pitch and/or or stadium are substantially essentially horizontal and substantially parallel in the wide image;
- f. Select selecting a rectangular region of interest within the wide image. This region contains e.g. the entire pitch and as much of the stadium as is required or visible; and
- g. [[Record]] storing the [[all]] computed values resulting from the calibration process to be used as the calibration parameters.

7. (Currently Amended) A method according to claim 6 further comprising the step of determining in which the steps of finding the lens distortion parameters parameter(s) for each camera, and correcting radial distortion in each image produced are comprised.

8. (Currently Amended) A method according to claim 6 further comprising the step of in which the step of selecting non-linear distortion parameters to reduce perspective distortion of the wide image is comprised.

9. (Canceled)

4 of 20

LEGAL02/31203265v1

Appl. No.: 10/564,286
 Amdt. dated May 11, 2009
 Reply to Office Action of February 10, 2009

10. (Currently Amended) A method ~~Method~~ according to claim 1 in which step b is performed automatically by an algorithm for identification of co responding features in concurrent video images and the coordinates for ~~these~~ the corresponding features are input via ~~[[to]]~~ a computer means.

11. (Currently Amended) A method ~~Method~~ according to claim 1 ~~which further comprising performing the following steps until completing the generation of the wide image video sequence comprises the following steps:~~

- a. applying ~~Apply~~ the calculated ~~computed and registered~~ calibration parameters; ~~[[.]]~~
- b. until the end of the sequence is reached, for ~~[[For]]~~ each pixel in the wide image, computing ~~compute~~ and storing ~~store~~ parameters describing (1) which ~~1. Which~~ pixels from which images ~~image(s) contributes~~ contribute to ~~[[this]]~~ the respective pixels ~~[[pixel]]~~ in the wide image ~~[[.]]~~ and (2) how ~~2. How much~~ each of the r ~~spective pixels contributes~~ these pixels each contribute to the wide image;
- b. ~~Repeat until the end of the sequence is reached;~~
- c. retrieving ~~Obtain~~ one new image from each camera;
- d. selectively ~~If required, update~~ updating the parameters needed to transform intensities ~~(colours/brightness)~~ in one or more of the cameras to eliminate visible seams;
- e. selectively ~~If necessary, adjust the~~ adjusting intensities ~~(colours/brightness)~~ in the images from one or more of the cameras; and
- f. creating ~~Create~~ the current seamless, wide image from the current images from each camera;
- g. outputting ~~Output~~ the wide image to a display or to a memory storage area ~~means~~; ~~[[; and]]~~
- b. ~~End of sequence. Return to step b until end of generation of the wide image video sequence.~~

Appl. No.: 10/564,286
 Amdt. dated May 11, 2009
 Reply to Office Action of February 10, 2009

12. (Currently Amended) A method ~~Method~~ according to claim 11, wherein the new images from each camera are read from live sources, each such source comprising a video camera.

13. (Currently Amended) A method ~~Method~~ according to claim 11 wherein the new images from each video camera are read from a memory storage area means.

14. (Currently Amended) A device having at least two video cameras substantially co-located and arranged in a predetermined relationship to each other such that there will be an overlap between images from the respective cameras, a processor, at least one memory storage area, wherein the processor is configured to ~~In a device having a processor means, which executes instructions stored in at least one memory means, a method for generating video sequences comprising the steps of:~~

a. form a synthetic image from images of the respective cameras by (i) identifying corresponding parts in overlapping parts of the images, (ii) determining the relation between the respective coordinates for the pixels in the individual cameras and in the synthetic image, and (iii) calculating calibration parameters from said relation, said calculated calibration parameters being unique for the at least two cameras and their current location as related to the object being recorded ~~generating a set of calibration parameters related to a device having at least two video cameras which are arranged in a predetermined relationship to each other, said parameters being unique for the at least two cameras and their current location as related to the object being recorded;~~

b. recording synchronously record video sequences using each of said at least two video cameras[,,]; and

c. generate ~~generating~~ a wide image video sequence by combining from each of said synchronously recorded video sequences using said calculated calibration parameters.

15. (Currently Amended) The device of ~~In a device, according to~~ claim 14, wherein the method in which the synchronously recorded video sequences are stored in a memory storage area ~~a memory means~~.

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

16. (Currently Amended) ~~The device of In a device according to~~ claim 14, wherein ~~the method in which~~ the synchronously recorded video sequences are used concurrently for generating the wide image video sequence.

17. (Currently Amended) ~~The device of In a device according to~~ claim 14, wherein ~~the method in which~~ to calculate the method in which the generation of calibration parameters, the processor is further configured to comprises the following steps:

- a. ~~Start of start~~ a calibration process;
- b. ~~Synchronize~~ synchronize the sequences from each of the at least two cameras ~~camera, which means that at least a video sequence has to be recorded by all cameras;~~
- c. ~~Compute~~ compute inter-image projective transformations;
- d. ~~[[Use]]~~ use the transformations to refer each image to a common reference frame;
- e. ~~Choose~~ select a real or virtual reference camera such that certain lines on the pitch ~~and/or or~~ stadium are substantially ~~essentially~~ horizontal and substantially parallel in the wide image;
- f. ~~Select~~ select a rectangular region of interest within the wide image. ~~This region contains e.g. the entire pitch and as much of the stadium as is required or visible; and~~
- g. ~~[[Record]]~~ store the ~~[[all]]~~ computed values resulting from the calibration process to be used as the calibration parameters.

18. (Currently Amended) ~~The device of In a device according to~~ claim 14, wherein to calculate the method in which the generation of calibration parameters, the processor is further configured to determine the following steps of finding the lens distortion parameters ~~parameter(s)~~ for each camera, and correct ~~correcting~~ radial distortion in each image produced are comprised.

19. (Currently Amended) ~~The device of In a device according to~~ claim 14, wherein to calculate the ~~method in which the generation of~~ calibration parameters, the processor is

Appl. No.: 10/564,286
 Amdt. dated May 11, 2009
 Reply to Office Action of February 10, 2009

further configured to select the following step of selecting non-linear distortion parameters to reduce perspective distortion of the wide image is comprised.

20. (Canceled)

21. (Currently Amended) The device of In a device according to claim 14, wherein the method in which step b is performed automatically by an algorithm for identification of corresponding features in concurrent video images and the coordinates for these corresponding features are input to a computer storage area means.

22. (Currently Amended) The device of In a device according to claim [[9]] 14, wherein the processor is further configured to the method which comprises the following steps:

- a. apply ~~Apply~~ the calculated ~~computed and registered~~ calibration parameters;[[.]]
- b. until the end of the sequence is reached, for [[For]] each pixel in the wide image, compute ~~compute~~ and store ~~store~~ parameters describing (1) which ~~1-Which~~ pixels from which images ~~image(s) contributes contribute~~ to [[this], the respective pixels [[pixel]] in the wide image[[.]] and (2) how ~~2-How~~ much each of the r ~~spective pixels contributes~~ these pixels each contribute to the wide image;
- b. ~~Repeat until the end of the sequence is reached;~~
- c. retrieve ~~Obtain~~ one new image from each camera;
- d. selectively ~~If required, update~~ update the parameters needed to transform intensities (~~colours/brightness~~) in one or more of the cameras to eliminate visible seams;
- e. selectively ~~If necessary, adjust the~~ adjust intensities (~~colours/brightness~~) in the images from one or more of the cameras; and
- f. create ~~Create~~ the current seamless, wide image from the current images from each camera;
- g. output ~~Output~~ the wide image to a display or to a memory storage area means.[[; and]]

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

~~b. End of sequence. Return to step b until end of generation of the wide image video sequence.~~

23. (Currently Amended) The device of In a device according to claim 22, wherein the method wherein the new images from each camera are read from live sources, each such source comprising a video camera.

24. (Currently Amended) The device of In a device according to claim 22, wherein the method wherein the new images from each video camera are read from a memory storage area means.

25. (Currently Amended) A computer ~~readable memory means storing a program for generating a wide image video sequence~~ readable medium having computer-readable program code portions stored therein, the computer-readable program code portions comprising executable portions that cause a device having at least two video cameras substantially co-located in a predetermined relationship to each other such that there will be an overlap between images from the respective cameras to which executes the steps of:

a. form a synthetic image from images of the respective cameras by (i) identifying corresponding parts in overlapping parts of the images, (ii) determining the relation between the respective coordinates for the pixels in the individual cameras and in the synthetic image, and (iii) calculating calibration parameters from said relation, said calculated calibration parameters being unique for the at least two cameras and their current location as related to the object being recorded ~~generating a set of calibration parameters related to a device having at least two video cameras which are arranged in a predetermined relationship to each other, said parameters being unique for the at least two cameras and their current location as related to the object being recorded;~~

b. ~~recording~~ synchronously record video sequences using each of said at least two video cameras[,,]; and

c. generate ~~generating~~ a wide image video sequence by combining from each of said synchronously recorded video sequences using said calculated calibration parameters.

9 of 20

LEGAL02/31293265v1

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

26. (Currently Amended) The computer-readable medium of A-memory means storing a program according to claim [[17]] 25, wherein in which the synchronously recorded video sequences are stored in a memory storage area means.

27. (Currently Amended) The computer-readable medium of A-memory means storing a program according to claim [[17]] 25, wherein in which the synchronously recorded video sequences are used concurrently for generating the wide image video sequence.

28. (Currently Amended) The computer-readable medium of A-memory means storing a program according to claim [[17]] 25, wherein to calculate the in which the generation of calibration parameters, the computer-readable medium further comprises executable portions that cause the device to comprises the following steps:

- a. Start of start a calibration process;
- b. Synchronize synchronize the sequences from each of the at least two cameras camera, which means that at least a video sequence has to be recorded by all cameras;
- c. Compute compute inter-image projective transformations;
- d. [[Use]] use the transformations to refer each image to a common reference frame;
- e. Choose select a real or virtual reference camera such that certain lines on the pitch and/or or stadium are substantially essentially horizontal and substantially parallel in the wide image;
- f. Select select a rectangular region of interest with in the wide image. This region contains e.g. the entire pitch and as much of the stadium as is required or visible; and
- g. [[Record]] store the [[all]] computed values resulting from the calibration process to be used as the calibration parameters.

29. (Currently Amended) The computer-readable medium of claim 28, further comprising executable portions that cause the device to determine A-memory means storing a program according to claim 28, in which steps of finding the lens distortion

Appl. No.: 10/564,286
 Amdt. dated May 11, 2009
 Reply to Office Action of February 10, 2009

parameters parameter(s) for each camera, and correct ~~correcting~~ radial distortion in each image produced ~~are comprised~~.

30. (Currently Amended) The computer-readable medium of claim 28, further comprising executable portions that cause the device to select ~~A memory means storing a program according to claim 28, the step of selecting~~ non-linear distortion parameters to reduce perspective distortion of the wide image ~~is comprised~~.

31. (Canceled)

32. (Currently Amended) The computer-readable medium of claim 28, wherein A ~~memory means storing a program according to claim 28, in which~~ step b is performed automatically by an ~~[[and]]~~ algorithm for identification of corresponding features in concurrent video images and the coordinates for the ~~these~~ corresponding features are input to a computer means.

33. (Currently Amended) The computer-readable medium of claim 28, further comprising executable portions that cause the device to ~~A memory means storing a program according to claim 28, which comprises the following steps:~~

a. apply ~~Apply~~ the calculated ~~computed and registered~~ calibration parameters; ~~[[.]]~~

b. until the end of the sequence is reached, for ~~[[For]]~~ each pixel in the wide image, compute ~~compute and store~~ parameters describing (1) which ~~1-Which~~ pixels from which images ~~image(s) contributes~~ contribute to ~~[[this] the respective pixels~~ ~~[[pixel]]~~ in the wide image ~~[[.]]~~ and (2) how ~~2-How much~~ each of the ~~respective pixels contributes~~ ~~these pixels each contribute~~ to the wide image;

b. ~~Repeat until the end of the sequence is reached;~~

c. retrieve ~~Obtain~~ one new image from each camera;

d. selectively ~~If required, update~~ update the parameters needed to transform intensities ~~(colours/brightness)~~ in one or more ~~of the~~ camera to eliminate visible seams;

11 of 20

LEGAL02/31293265v1

Appl. No.: 10/564,286
 Amdt. dated May 11, 2009
 Reply to Office Action of February 10, 2009

e. ~~selectively~~ If necessary, adjust the ~~adjust~~ intensities (colours/brightness) in the images from one or more of the cameras; and

f. ~~create~~ Create the current seamless, wide image from the current images from each camera;

g. ~~output~~ Output the wide image to a display or to a memory storage area means. [[; and]]

h. ~~End of sequence. Return to step b until end of generation of the wide image video sequence.~~

34. (Currently Amended) The computer-readable medium of claim 28, A memory means according to claim 28, wherein the new images from each camera are read from live sources, each such source comprising a video camera.

35. (Currently Amended) The computer-readable medium of claim 28, A memory means according to claim 28, wherein the new images from each video camera are read from a memory storage area means.

36. (Currently Amended) A video recording apparatus having at least two video cameras substantially co-located in a predetermined relationship to each other such that there will be an overlap between images from the respective cameras, the video recording apparatus comprising:

a microprocessor (130); microprocessor(130);

a memory storage area means (120) [[for]] storing a program for; ~~generating a set of calibration parameters related to a device having at least two video cameras which are arranged in a predetermined relationship to each other, said parameters being unique for the at least two cameras and their current location as related to the object being recorded;~~

a. forming a synthetic image from images of the respective cameras by (i) identifying corresponding parts in overlapping parts of the images, (ii) determining the relation between the respective coordinates for the pixels in the individual cameras and in the synthetic image, and (iii) calculating calibration parameters from said relation, said

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

calculated calibration parameters being unique for the at least two cameras and their current location as related to the object being recorded,

b. _____ synchronously recording video sequences using each of said at least two video cameras, and

c. _____ generating a wide image video sequence by combining said synchronously recorded video sequences using said calculated calibration parameters,

~~said memory means (120) also storing program for recording of wide image video sequences;~~

a read and write memory storage area means (140) for storing data relating to recorded video sequences from the at least two video cameras;

an input component [[means]] (300) for receiving input of manual input of parameters, and input of recorded video sequences;[[.]] and

an output component [[means]] (300) for output outputting of a wide image video sequence.